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312 731 larly its major commercial artery, Nanking Road, which follows fairly closely the course of a small creek culverted early in the period of foreign occupance (map 6). It was thus one of the most frequently flooded areas in the city. Paving along this heavily traveled street through the heart of the hotel and retail district was removed for nearly a mile back from the river, and replaced after the ground level had been raised sufficiently to protect it from all but the worst floods.

● 364 505 The numerous tidal creeks (map 6), characteristic of the lower delta, were useful in the early days of the Settlements as master drains and for demarcating legally and defending militarily Settlement boundaries. They were also used for carrying off sewage, where their tidal ebb was an advantage, and for movement of goods within the city and to and from the hinterland. The so-called Defense Creek at the western limit of the British Settlement of 1848 (map 6) was culverted and covered with a roadway in 1906, a few years after the Settlement had reached its greatest areal extent in 1899, but the Yang Ching Pang, which formed the boundary between the French and International Settlements on the south, remained an open sewer and transport artery until 1915, when as an enclosed culvert it was covered over with a broad boulevard named Avenue Edward VII as a gesture of ideological if not political unity between France and Great Britain. The remaining uncovered creeks are still important transport arteries, and as such key factors in the economic life of the city. While Shanghai has at least to this extent turned its delta site to advantage (and in a largely unique way as we shall see below), the problems which the delta has presented far outweigh its benefits.

The City

361 The site of the original British Settlement, on the left bank of the Whangpoo at its confluence with Soochow Creek, was determined by the existing walled Chinese city just upstream, whose trade had attracted British interest in a concession there (map 6). Soochow Creek, the original natural and later canalized waterway to the leading delta city of Soochow for which Shanghai served as the port, was the primary factor fixing the Chinese city, and it was

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naturally built on the outside of the bend in the Whangpoo, where tidal scour cut a channel and where it could tap a larger hinterland than on the inside of the bend. It may be assumed that the Chinese city was originally at the junction of Soochow Creek and the Whangpoo, and that since its founding in approximately the fourth century A.D., deposition and alterations in the character of both Creek and River (see the next section of this chapter) have left the city on the Whangpoo about 5000 feet upstream from the Creek's mouth. A considerable area was thus left between the city walls and the mouth of Soochow Creek, and here the British Settlement was established.

Sir Henry Pottinger, head of the British delegation at the Treaty of Nanking, selected the site for the British Settlement at Shanghai on his way back from signing the Treaty, his choice being influenced by strategic considerations.[8] The area he fixed on was the little square bounded on three sides by defensible waterways and on the fourth by the navigable Whangpoo (map 6). The main suburbs of the Chinese city lay between its wall and the Yang Ching Pang, while north of this creek the land-use was agricultural.

The boundaries of the original British leasehold of 1843 and later additions, and of the original French leasehold of 1849, made close use of existing waterways. These were useful not only for demarcation and defense, but also for sewage disposal, drainage, and transport, although not for drinking since they were both brackish and polluted. Roads (including Nanking Road) were built over many of these streams, but they continued to act as sewers. The course of Defense Creek and its junctions suggest that it was canalized for at least part of its length and diverted to supply the moat of the Chinese city, supplementing the water also received from the three other creeks emptying into the moat.

There are no contemporary accounts of natural levees anywhere on this site in 1843, and the possibility of their existence is lessened by the contemporary pattern of streams and canals as it can be reconstructed from period maps and records. Possibly the material which must have been deposited by Soochow Creek and Whangpoo flood waters along their respective banks was continually removed by local farmers in order to spread the alluvium over their fields

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creeks and canals as well) and settled in earthen jars with the help of alum to precipitate the mud. The water was then boiled and cooled, but this beverage was not held in much favor by the foreign community, and beer, wine and spirits imported from abroad filled most of the needs of at least the male foreign residents, aside from the missionaries. In 1883 a foreign-owned and directed water company under contract to the Shanghai Municipal Council began to supply water to the foreign community in pipes, and this service was gradually extended to Chinese residents of the Settlement after 1884, primarily to help prevent disease, which could so easily spread. This water, pumped from the Whangpoo, was purified by slow sand filters, alum, and chlorine, but it remained unpalatable and was distributed to less than 10,000 users in all until the turn of the century. The intake for this plant has remained on the Whangpoo below the city in south Yangtzepoo.[11]

Location downstream from the city enables the plant to draw on the tidal inflow from the Yangtze, which is less contaminated, fresher, and less muddy near the surface than what the Whangpoo brings down. The widespread use of city refuse of all kinds for fertilizing fields and for filling low-lying land makes a downstream location so near the city less of a danger than it would be in most Western cities. The Whangpoo may originally have been a tidal salt water creek which later benefitted from stream piracy in making connections with a fresh-water stream or streams farther inland as its own headwaters. Such a possibility is suggested by the Whangpoo's short total course compared with the volume of water it carries, by the sharp right-angle bend it makes in flat alluvial country about ten miles above Shanghai (map 5), and by what is known of the hydrographic history of this area, which is discussed in greater detail below.

This private British-owned company, the Shanghai Waterworks Ltd., continued to provide about half of the piped water supply of the entire city until 1936, by which time it distributed a daily average of about 54 million gallons. It was supplemented in 1903 by a company owned by the government of the French Settlement with an intake above the city on the Whangpoo, and also using sand filters, alum, and chlorine to supply a daily average of about 32 million

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gallons by 1936. Two Chinese-owned waterworks were also in operation, one in Chapei (part of the Chinese municipality — map 3) established in 1921 and drawing water from an intake on the Whangpoo just above Woosung. This was the largest Chinese-owned waterworks in China, and supplied an average of about ten million gallons daily. The other Chinese waterworks was built in 1906 in Nantao, with an intake just upstream from that of the French company, but it operated intermittently until 1930, and by 1936 supplied only about three million gallons daily. These two Chinese waterworks served a tiny fraction of the Chinese population outside the foreign settlements, primarily in the areas immediately adjoining the Settlements on the northwest and south. Both plants used sand filters and chlorine to purify their water, but in 1926 the supply of the Chapei company was found to be grossly polluted and probably responsible for a cholera epidemic in that year in which several foreign as well as several hundred Chinese cases were reported.[12]

Aquiferous sand strata with water pockets of some size underlie parts of the city's site at depths of 100 feet or more, and most of the textile and paper factories have tapped this relatively pure and soft water by wells deeper than those dug during the early days of the Settlement. Drilling in the alluvium is cheap, but while water thus obtained appears to be satisfactory for soft-water using industries, it is questionable whether it is renewable and will not soon be exhausted, and certainly whether it is adequate to supply even a small part of the city's needs.

Despite the chemical purity of the water supplied by at least the two foreign companies, most foreign residents continued into the 1930's to boil and filter it before using it for drinking, an old habit which died hard and which was doubtless prolonged by the unpleasant taste of the heavily treated water. The total piped and treated water consumption of the entire city in 1936, approximately 100 million gallons a day exclusive of private wells, would not have supplied New York in the same year (with a population a little less than twice that of Shanghai) for more than two and a half hours.*

* New York used approximately one billion gallons a day in 1936, according to the 1936 edition of the New York *World Almanac*.

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In the early years of the foreign settlements when foreigners were permitted into the hinterland for half a day's travel from the city (since they were originally not allowed to spend a night beyond the Settlements), they moved very largely by boat, and "they inevitably met on the way dung boats, dung tanks, dung buckets, and dung carriers wherever they went."[49] Until 1923 (the 1925 population of Shanghai was approximately 2,300,000, including 29,000 foreigners), there were virtually no flush toilets anywhere in the city and no central sewage system. The human wastes (or night soil) and the garbage of the city, in common with the usual practice in east Asia, were carefully saved and "sold" to contractors, who were paid a small fee for their services in removing the wastes and distributing them for sale to the farmers of the delta. Up to 1923, when a central sewage system was installed, these night soil contractors collected the wastes at most of the houses in Shanghai, including the foreign houses, and were under contract to the Shanghai Municipal Council for the removal of wastes collected by the Council from public buildings and a few private houses within the International Settlement. The Council realized an average annual revenue between 1910 and 1920 of US$50,000 from these transactions.[50]

The Council made its first contract with the night soil collectors in 1867 because it was alarmed by the health menace presented by the promiscuous dumping of wastes of all kinds in the creeks which flowed through the Settlement. Night soil contractors had been operating in the Settlement for several years before this date, but they had not removed all of the wastes, and the Council in its new contract provided for a complete disposal system.[51] By 1932, the Health Commissioner of the International Settlement was defending this system as essential not only to the health of the Settlement but to the productivity of the farms which supplied it with food.[52] As a means of disposing of the city's refuse it also had notable advantages of economy, if not of attractiveness to the foreign residents. The Council estimated in 1920 that the cost of collection and disposal of household wastes in Shanghai over the period 1908–1919 averaged about 1s 2d per ton, as against an estimated cost in London at the same period of 9s 1d per ton.[53]

In 1923 the Council built the first central sewage system, which

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by 1934 included four sewage-treatment plants and two incinerators for household refuse. During the same period cesspools were dug for most buildings in the Settlement beyond the limits of the central sewage system. The night soil contractors continued to remove wastes from buildings without cesspools, and, by agreement with the Council, to drain the cesspools at regular intervals. Most of the sewage treated by the new plants was sold to the night soil contractors as before, but now in a concentrated form which was also less dangerous to health when used as fertilizer. Non-organic wastes were dumped at sea by the Council, or were used for raising low-lying land. Household garbage continued to be collected by the night soil contractors as before.[54] These malodorous cargoes went out from Shanghai entirely in barges, many of which were open and which were (and still are) to be seen on all of the waterways running through the city. It was these which attracted the adverse comment to which the Municipal Health Commissioner replied in the statement referred to above.

The night soil produced by two, three, or four million people and distributed to farmers must have been a not inconsiderable factor in maintaining or enhancing soil fertility and in making possible unusually high yields within a thirty- or forty-mile radius of Shanghai.* Existing figures for crop yields are unfortunately calculated on the basis of *hsien*, and *hsien* boundaries do not even approximately coincide with the thirty- or forty-mile radius. The Municipality of Greater Shanghai itself occupies 320 square miles (of which 210 square miles is listed as farm land) within the area of night soil distribution from the city. The effect of this distribution therefore cannot be measured with any accuracy in terms of crop yields, although the figures do show about 10 per cent higher yields of all crops in the *hsien* which have some part of their area within a forty-mile radius of Shanghai than in the remaining *hsien* in the Kiangsu section of the delta south of the Yangtze and east of Tai Lake.[55] Soil and land forms are generally uniform over this area. It is a readily observable fact that fields are greener and crops heavier and further advanced within a day's foot or water travel

* See above, p. 137. Buck's figure was compiled from surveys in only one district (about one quarter of one *hsien*) within this area.

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but until the occupation of the Settlement by Japanese forces in 1941, this document, the Settlement's constitution as it were, remained practically unchanged. Any change in Byelaws required the consent of a special meeting of ratepayers with a stipulated quorum of the Consular Body in Shanghai, of the Diplomatic Body. Changes in the Land Regulations required approval of the Chinese Government. A Chinese Government which resented the existence of areas alienated from its control refused to contribute to the perpetuation of foreign administration by agreeing to changes in Land Regulations. Thus for several decades prior to 1941 the Council had to proceed under an archaic set of constitutional powers. It possessed no specific power to deal with labour and social issues. After the occupation of the Settlement by Japanese forces and the consequent coming under Japanese direction of the whole Council administration, pseudo-changes in the Land Regulations were considered. No final information is available on this matter, but presumably the form would be gone through of submitting them to a Council which was under Japanese influence, to a compliant Consular and Diplomatic Body consisting of Axis and neutral representatives, and to the Japanese-sponsored Chinese Government in Nanking, whose consent to changes could, it is assumed, be obtained. By this procedure a semblance of legality would be sought. Whether legally obtained or not, the Nanking-stafed First Special District Court in Shanghai would apply byelaws derived from newly assumed basic powers in the Land Regulations.

The Organic Law Governing Municipalities promulgated by the Chinese Government in 1930 by comparison granted wide powers to municipalities created by that Government. In particular, Sub-section 5, Article 8 of this Law gave to municipalities the power to administer and bureaucratically to enforce provisions relating to labour.

Possibly because of the lack of enabling byelaws, but possibly also because concern with industrial and social issues came late in China itself, the Council's consideration of certain types of social problems was late also. It was natural that the first municipal emphases historically were logically on the maintenance of public order through police services; on the provision of public health services in a country where modern ideas of sanitation have lagged

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and where virulent disease is endemic; on the development of highways, sewerage and drainage systems; and, through franchises, on the supply of public utility services. Thirty years ago, however, it became evident that Shanghai was coming to be an important manufacturing city, and that a large industrial population would arise, brought to the city from rural areas by the hope of securing employment. The necessity, therefore, for concern with the social problems everywhere associated with a large industrial populace grew more urgent with the years.

IN THE 1920's FIRST EFFORTS were made by the Shanghai Municipal Council to regulate industrial conditions with the attempt, in 1925, to obtain passage of a byelaw which would limit the age of commencement of work for young people to 10, rising later to 12 years.[1] Until April 1941 the limitations on the Council's powers necessitated the summoning of a special meeting of ratepayers (voters) to alter or to add to any byelaw which might permit the Council to exert authority, provided it were not incompatible with the Land Regulations. Two special meetings of the ratepayers in 1925 lacked the necessary quorum of voters. The byelaw could not be passed.

Chinese residents in the Settlement subordinating social to patriotic motives opposed the proposed byelaw, for they did not desire the extension of the Council's powers into realms not specifically provided for in the Land Regulations and existing Byelaws. The year 1925 antedated the rise of the Chinese National Government which was to show a lively concern in labour matters, and at that time the Peking Government took only a perfunctory interest in the regulation of industrial conditions. On political grounds even socially minded Chinese leaders in the Settlement opposed the Council's assumption of control over labour conditions, notwithstanding that the issue was a humane one of preventing the exploitation of children. Although under the Land Regulations, attendance and voting at ratepayers' meetings were prerogatives of foreign (i.e. non-Chinese) ratepayers, this Chinese point of view was nonetheless forcefully made known in the Chinese press which has always freely criticised the Settlement administra-

[1] "Toward the Regulation of Child Labour," *Bulletin No. 1.* Joint Committee of Shanghai Women's Organisations, 1926.